AGRICULTURAL Research

AUGUST 1953

President Eisenhower visits Beltsville . . .

AGRICULTURAL
Research

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GOLDIE, Beltsville Holstein, gets admiring smiles from the President and Secretary Benson. Her record year's production: 21,117 pounds milk, 897 pounds butterfat. (*USDA photo by Forsythe.*)

Distinguished guests

The Agricultural Research Center at Beltsville, Md., just a few miles from Washington, was honored recently by a visit from President of the United States Dwight D. Eisenhower, accompanied by Secretary of Agriculture Benson and representatives of the Department of Defense and the armed services. Research in the interest of national defense is a part of the work program at Beltsville.

During his tour of ARA's 11,000-acre experimental farm, the President was briefed on projects of nationwide interest conducted there—including research to improve plant, animal, and dairy production, insect and disease control, and farm-product utilization.

A special luncheon (see photo), served in the employees' cafeteria at the Center, concluded the President's visit. The menu for this luncheon is described on page 16.

LUNCHEON featured buffet of new foods. At right, beside the President, is Dr. Hazel K. Stiebeling, chief of the Bureau of Human Nutrition and Home Economics. On the left, with Secretary Benson, is Dr. Byron T. Shaw, ARA Administrator, host for the luncheon.

Contents

VOLUME 1 of *Agricultural Research* was concluded with publication of the May–June number, last of three bimonthly issues. Volume 2, which began with the July number, is planned to contain 12 monthly issues.

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AGRICULTURAL RESEARCH ADMINISTRATION
United States Department of Agriculture

Making *Dextran* easier

An improved method of producing clinical dextran—vital for national defense as a blood-plasma supplement—recently passed pilot-plant tests at the Northern Regional Research Laboratory and is ready for commercial trial.

It eliminates one major step, and simplifies another, in the complex process used to manufacture dextran. The result is more efficient production and a higher quality product.

Since AGRICULTURAL RESEARCH's first report (Jan.–Feb. 1953) on this important new extender for blood plasma, dextran has been approved for general use in civilian as well as military medicine. Early production was rationed to the armed forces or stockpiled, but now part of the output goes into civilian use.

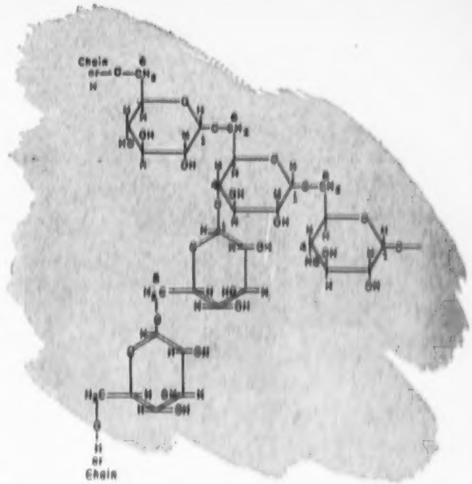
The research and development that has made dextran available to all our doctors and their patients was done cooperatively by the Northern Laboratory, National Bureau of Standards, and several private industrial concerns, under supervision of the National Research Council.

When properly prepared and injected into the bloodstream, dextran is just as effective in alleviating shock as blood plasma. This is due to dextran's ability to absorb and hold water from body tissues, just as blood-plasma proteins do. Thus it can replace plasma lost as a result of bleeding, and it also aids the body in making a natural readjustment of blood volume by absorbing water released to body tissues as a result of shock.

But dextran molecules can behave like blood-protein molecules only when they are the right size. The dextran commonly produced in nature—by bacterial fermentation of ordinary sugar—has molecules that are much too large. They must be chopped up chemically to proper length for use in the blood. Doing this efficiently is the secret of making clinical dextran.

Like starch and cellulose, dextran is a polymer of the sugar glucose—that is, it consists of long chains of glucose molecules linked together in a special way. (Each hexagonal figure in the diagram above represents one glucose molecule.)

Native dextran—the natural product—has long-chain molecules varying in molecular weight from 1 million to several hundred million. But molecules of clinical dextran must weigh about (*Continued on p. 14*)



Representative portion of a dextran molecule.

THE BUREAU of Agricultural and Industrial Chemistry's Northern Regional Research Laboratory at Peoria, Ill., has played much the same role in dextran research that it did, 10 years ago, in research leading to large-scale production of the drug penicillin.

The microorganism used to produce clinical dextran—a strain of the bacterium *Leuconostoc mesenteroides* known as NRRL B-512—came from the laboratory's renowned microbe collection. (It was found originally in a bottle of spoiled root beer.) Laboratory scientists also discovered (on a moldy cantaloupe) the first high-yielding strain of the penicillin organism.

Manufacture of both penicillin and clinical dextran in the U. S. is based in large part on chemical and fermentation studies made at the Peoria laboratory. Its dextran team, led by C. E. Rist, includes members of the starch, fermentation, physical chemistry, and engineering research divisions.

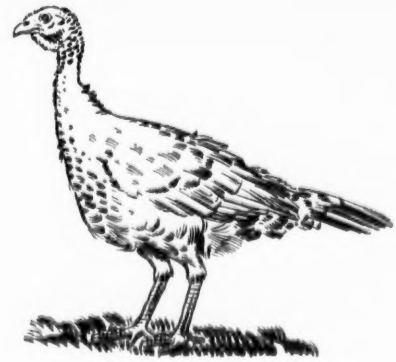
Secretary appoints new members to research policy group

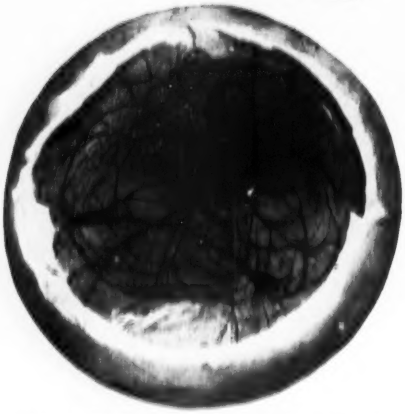
Secretary of Agriculture Ezra Taft Benson has announced the appointment of eight new members to the 11-man Agricultural Research Policy Committee, organized under the Research and Marketing Act as a national advisory group concerned with USDA research activities.

They are: ROY BATTLES, assistant to the Master of the National Grange; FRANK HAUMONT, farmer and chairman of the Nebraska Farmers Union legislative committee; C. W. KITCHEN, executive vice president, United Fresh Fruit and Vegetable Association; CHARLES W. SAYRE, president and general manager, Delta and Pine Land Company, Scott, Miss.; ROBERT B. TAYLOR, wheat farmer, Adams, Ore.; H. W. VORHEES, president, New Jersey Farm Bureau; FRANK J. WELCH, Dean of the College of Agriculture and Director of the Experiment Station and Extension Service, University of Kentucky; and PAUL S. WILLIS, president, Grocery Manufacturers of America, Inc.

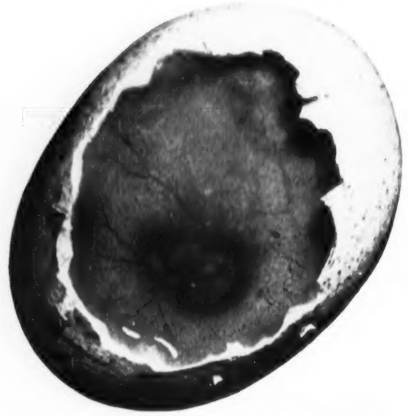
Incumbent members include HOMER L. BRINKLEY, executive vice president, National Council of Farmer Cooperatives; ANSON A. BROCK, director of the California Department of Agriculture; and CHARLES G. KING, scientific director, Nutrition Foundation, Inc., and professor of chemistry at Columbia University.

Discovered in turkey eggs: PARTHENOGENESIS

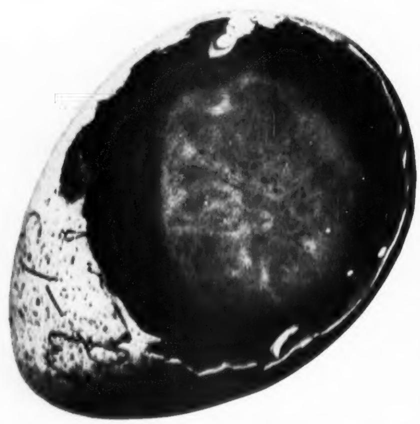




NORMAL fertile egg, incubated for 8 days, has a well-developed system of blood vessels around embryo. *(USDA photos by Stenhouse.)*



RETARDED embryo, in egg laid 195 days after hen was isolated, took 11 days incubation to reach the size of a normal 6-day empryo.



UNORGANIZED cell growth, without embryo formation, typifies most parthenogenesis in turkey eggs. This egg was incubated 7 days.

Scientists at ARA's Beltsville research center have made the remarkable discovery that embryos can develop in unfertilized turkey eggs.

M. W. Olsen and S. J. Marsden of the Bureau of Animal Industry found retarded embryos and embryonic membranes in 15 percent of eggs laid by turkey hens 3 to 6 months after isolation from male birds. Further studies, still in progress, reveal embryonic tissue in eggs from Beltsville Small White hens that have been kept from all contact with mature male turkeys.

These are the first cases of advanced natural parthenogenesis—or spontaneous development of embryos without normal fertilization—ever reported in birds or other higher animals. Their discovery is important not only for poultry research and the turkey industry, but possibly also for research on cancer.

Natural parthenogenesis is common in the lower animals—bees and aphids, for example. Embryo development can also be induced artificially in some of these animals by chemical or mechanical means. When infertile frog eggs are pricked with a needle, some of them start development and a few will produce tadpoles.

But such tricks of nature were unknown in higher animals, and Olsen and Marsden considered carefully whether turkey males might, after all, have fathered the unusual embryos.

Females of some animals have produced fertile eggs long after mating. The queen bee reportedly can keep spermatozoa alive in her body for 7 years. Sperm cells live inside the female turkey much longer than in most birds, and poults have been hatched from turkey eggs laid 50 days after mating. An occasional fertile egg has been found 70 days after a single artificial insemination.

But some of the Beltsville hens far surpassed this record. Embryonic membranes developed in about 90 out of 600 eggs laid 100 to more than 200 days after the hens were removed from the males.

Furthermore, these hens had been segregated almost 2 months before they began laying. Their immaturity, plus the fact that turkey matings occur only by invitation of the female—usually just before or during the laying period—made it unlikely that the eggs had been fertilized.

To check their findings, however, Olsen and Marsden set up new tests, using hens that were isolated from other birds when 4–12 weeks old and never allowed contact with mature male turkeys. These studies, though not yet completed, show positively that

some infertile turkey eggs develop embryonic tissue upon incubation.

The parthenogenic development is slow in starting and continues for only a few days. It is not visible to the candler until the eggs have incubated about 5 days. Embryos in normal fertilized eggs show up 18–24 hours after they are put in the incubator.

A few parthenogenic embryos develop almost normally (see pictures). But these are rare. In most cases (98%), cell development is unorganized and produces simply a translucent membrane that spreads, cap-like, to cover part or all of the egg yolk.

This abnormal growth of tissue, where none should develop—and the puzzling fact that something makes cell growth begin only after 3–4 day's incubation of the egg—gives Olsen's and Marsden's discovery its interest for cancer research.

What causes this strange development? The scientists don't yet know. But they believe it may be related to hormone imbalance in the hens that lay the eggs, possibly traceable to the pituitary gland. Not all turkey hens produce eggs of this type, but some lay many of them.

And what does this have to do with "the price of eggs"? Well, turkey eggs cost hatcherymen 25 cents or more each. Even so, a discouragingly large number of them won't produce young turkeys.

Parthenogenic cell tissue could account for some apparently fertile eggs that won't hatch out. Researchers now suspect that much old data on turkey-egg hatchability may be wrong. Many eggs that looked fertile when candled, but failed to hatch poults in past experiments, might not have been fertile at all.

Olsen's and Marsden's findings add up to the kind of basic discovery that calls for another look at past research—and points toward a clearer view of life processes in future.

The difference is Diet

Hog raisers want to save more pigs per litter and grow them bigger by weaning time. Better diets—for sows as well as pigs—may help do both.

J. W. Stevenson studied 94 spring and fall litters of 50 sows at the Agricultural Research Center. He found pig losses ran highest for sows fed a ration with 15 percent protein—commonly thought adequate—during the gestation period. One pig out of four died the first week, and total deaths averaged about 30 percent.

Losses were strikingly lower when sows got an aureomycin-vitamin B_{12} supplement along with the 15-percent gestation ration. First-week mortality was less than 1 pig in 10, the total about 15 percent.

Equally good results were recorded on sows fed a 20-percent-protein diet without the aureomycin-B_{12} supplement. Losses were reduced still more when the supplement was added to this high-protein fare.

Thus, both antibiotic and extra protein fed during the gestation period appear to make for stronger pigs at birth. Perhaps the antibiotic helps maintain better health by battling undesirable bacteria. It may also be important that the 20-percent ration is high in vitamins, since this protein level is reached by adding more vitamin-rich soybean meal, tankage, fish meal, and linseed meal.

Increased protein in the nursing ration apparently didn't affect the weight of pigs at weaning. But creep feeding of supplemental pig feed made a big difference.

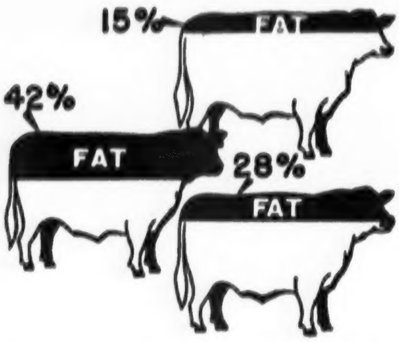
Pigs with access only to the sow's self-feeder averaged about 26 pounds at weaning. Creep-fed litters averaged 37 pounds. These pigs got a pelleted diet including rolled oats, ground yellow corn, fish meal, soybean oil meal, nonfat milk solids, dried brewers' yeast, dehydrated alfalfa meal, cane molasses, iodized salt, minerals, antibiotic and vitamin supplements, and irradiated yeast.

This feed contained 22 to 23 percent protein and was easier to digest than the more fibrous rations fed the sows. Pigs found the crunchy pellets highly palatable.

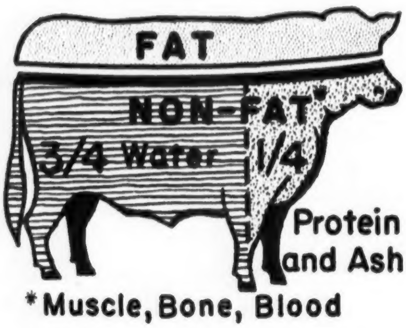
Bureau of Animal Industry scientists are continuing this study of the effect of diet on livability and gains.

CREEP-FEEDING of pelleted supplement increased weaning weight in the Beltsville trials.

How much is *Fat?*



1 Steer's fat content may run from less than 15 to as much as 50 percent of total body weight, depending on feeding, breeding. Hogs, sheep, goats vary widely, too. Until recently, only way to measure fat accurately was to kill animals. New test is better way.



2 Composition of nonfat (muscle, bone) part of body is about the same for any animal—¼ protein and ash, ¾ water. Thus by measuring the amount of water in the body, we can figure how much the nonfat portion weighs. The rest of the total weight is obviously fat.

A test for measuring the fatness of live cattle, hogs, sheep, and goats provides a valuable new tool for research in nutrition and breeding.

Scientists H. F. Kraybill, O. G. Hankins, and H. L. Bitter of the Bureau of Animal Industry perfected this test for use with livestock. Their achievement confirms experimental results obtained by medical researchers, who first developed the technique.

Such a test has been sought for a long time. Ordinary commercial grading—"looking them over"—is satisfactory for marketing livestock. But research needed a more precise way to measure the relative proportions of bone, muscle, and fat in a live meat animal.

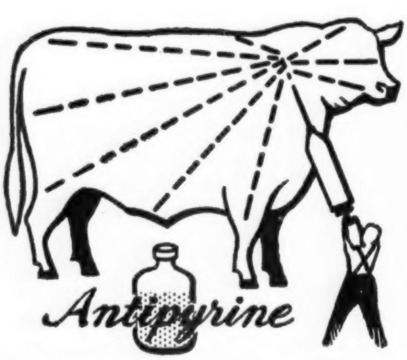
A drug called antipyrine, best known for its use in medicine to break fever and relieve pain, is the basis of the new test. After injecting a measured dose of antipyrine into an animal, scientists can analyze the blood and determine the body's water content. With this figure, plus total body weight, it's possible to figure the percentage of fat.

Nutrition specialists can use the antipyrine test to check the fatness of young animals at the beginning of feeding tests. Thus, both fat increase and total gain can be measured in terms of feed cost.

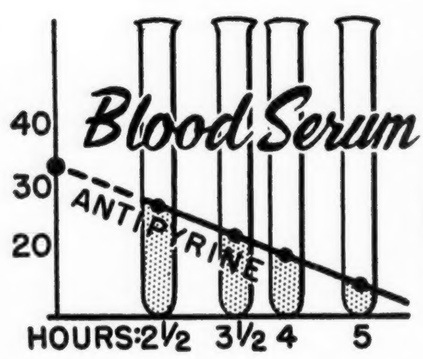
Cattle breeders may find the test helpful in selecting sires with the ability to transmit early market finish. Bull calves could be checked early rather than waiting for their first crop of calves.

With interest growing in meat-type hogs, antipyrine may be used to choose lean boars and gilts that can make fast, efficient gains.

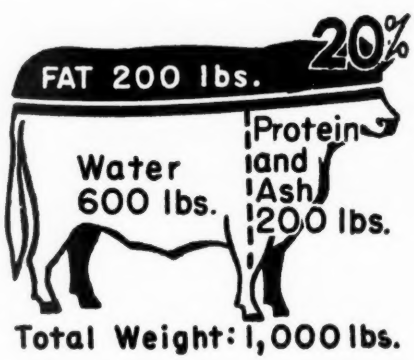
Measuring fat by the antipyrine method involves several hours of field and laboratory work. For that reason, the test is likely to find greater immediate use in breeding and research than in marketing.



3 Antipyrine is used to measure body water. Injected in animal, drug spreads thoroughly and combines with water. Distribution takes 2½ hours with cattle, less time with smaller animals. Concentration of drug in body water is measured by analyzing fluid part of blood.



4 Blood samples are taken as antipyrine moves through body and begins to be eliminated. Extending antipyrine line to the left in chart indicates what the drug concentration would have been at the time of injection—if instant distribution of drug were possible.



5 Knowing drug level in serum, tester can figure body water required to absorb all the antipyrine at that level. This steer contains 600 pounds of water. This is ¾ of nonfats, so total muscle and bone are 800 pounds. The animal's remaining 200 pounds are fat.

New development on Kidney Stones

A NEW development in the old problem of kidney stones in cattle and sheep is reported by Bureau of Animal Industry scientists.

The fact that these stones respond to the drug hyaluronidase, widely used to treat the same ailment in humans, was noted recently by I. P. Earle and I. L. Lindahl. Though such treatments aren't practical for livestock, this discovery may help find out what's behind the disorder.

Kidney stones, known to science as urinary calculi, have caused considerable trouble in southern Great Plains cattle. Mineral deposits form in the kidneys, bladder, and urinary passages. Animals often die from the swollen condition called "water belly," which occurs when the urethra gets plugged up with a large stone or several small ones.

Feed-lot experiments at the Bureau's Big Spring (Tex.) Field Station indicate that stone formation is directly related to the use of sorghums—main carbohydrate concentrate of the region—in fattening steers.

Studying the calculi from animals at Big Spring, scientists found: (1) small, hard pellets of silica (the silicon-oxygen compound best known as ordinary sand); (2) silica pellets coated with layers of easily-crushed material high in phosphorus and magnesium; and (3) loose masses of the phosphorus-magnesium material.

Southwest feed-lot diets are apt to be high in magnesium and low in calcium. So experiments were set up to try adjustments in the calcium, phosphorus, and magnesium levels of the ration. These tests gave no conclusive results.

Silica, however, was a different matter. Analysis showed that some sorghum products fed to the Big Spring steers were high in silicon. Furthermore, tests revealed a high silicon content in the grasses of certain areas from which feeders hesitate to buy calves because of their tendency to have kidney stones.

Research with sheep at the Agricultural Research Center now indicates that silicon not only is absorbed but also influences magnesium and phosphorus intake. As additional silicon is added to the diet, sheep develop more and more kidney stones.

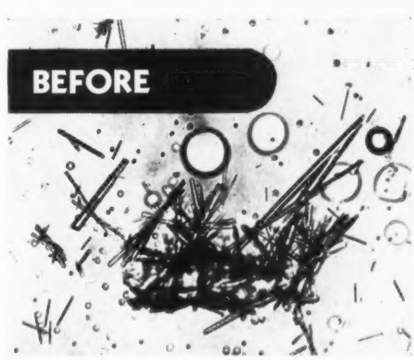
It appears that the hard silica centers of these stones may begin back on the range, long before steers reach the feed lot. Deposits build up around the pellets when the animals go on a mineral-rich diet.

Strong evidence has now developed that an additional factor may enter into the formation of calculi.

Earle and Lindahl noted medical research reports that "protective colloids" in the urine of healthy individuals prevent mineral crystals from cementing together and forming stones. It was found recently that a colloid shortage in humans can be relieved by daily injections of the enzyme hyaluronidase.

The Bureau's scientists decided to try this drug with sheep. The pictures below show the results.

Kidney stones are a complex problem, and more research may reveal that still other factors are involved. Present work with sheep is being devoted to (1) relation of diet to urinary colloids and relation of colloids to stone formation, and (2) the dietary effects of silicon.



STONE-forming mineral crystals (magnified) show in urine of sheep with stone in kidney.

CLEAR temporarily, 2 hours after hyaluronidase injection released protective colloids.

DAIRY

Many dairymen like

LOOSE HOUSING . . .

Loose housing, developed through research during the past decade, has proved good for cows and efficient for dairymen. Hundreds of dairy farms now use this system.

A new ARA bulletin, just released, tells farmers how to plan and operate this kind of dairy layout. It's Agriculture Information Bulletin No. 98, by Thayer Cleaver and R. G. Yeck of the Bureau of Plant Industry, Soils, and Agricultural Engineering.

As the name implies, loose housing lets the cows run relatively free. The system is flexible and adjusts easily to individual dairy-herd requirements. It includes separate areas for resting, feeding, and milking—all arranged for efficient, economical operation.

Loose-housed cows go to their feed—it's not brought to them. They take shelter as they wish. They are milked in an easy-to-clean milking parlor.

This differs from the older stall-barn system, which provides a separate stall for each cow. In winter, except for brief exercise, cows are kept in the stalls.

Cows under loose housing grow thick, winter coats and don't suffer from cold. They have adequate shelter in bad weather. Manure and bedding are allowed to accumulate in the resting area during the winter, when flies are no problem. The manure pack forms a soft bed on which cows like to lie. It also generates some heat. Most of the manure's fertility is conserved, and it's removed before the fly season begins.

If well managed, cows keep at least as clean in loose housing as in a stall barn, and they have less trouble with stiff hocks and swollen knees.

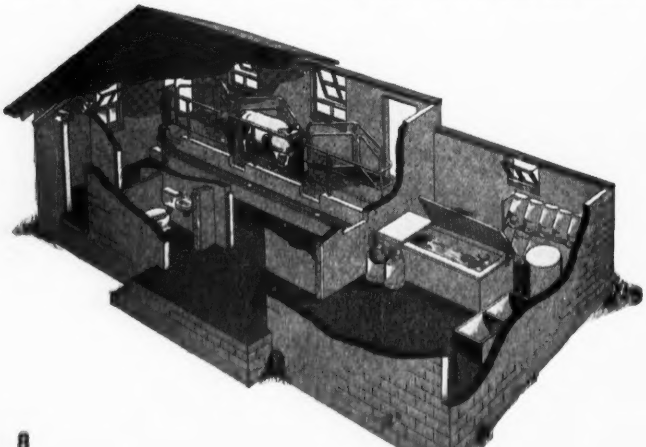
Successful loose housing requires a good arrangement and careful management practices. There are some disadvantages. For example, men caring for the animals are more exposed to the weather than in stall barns. Also, the cows should be dehorned.

But the loose-housing scheme offers new opportunity for better dairy operations. Labor-saving equipment—including tractor-operated cleaning gear, automatic watering systems, self-feeding devices, and pipeline milking—all fit naturally into the system. Building costs are less per cow, and herd size can be increased without large outlays for shelter.

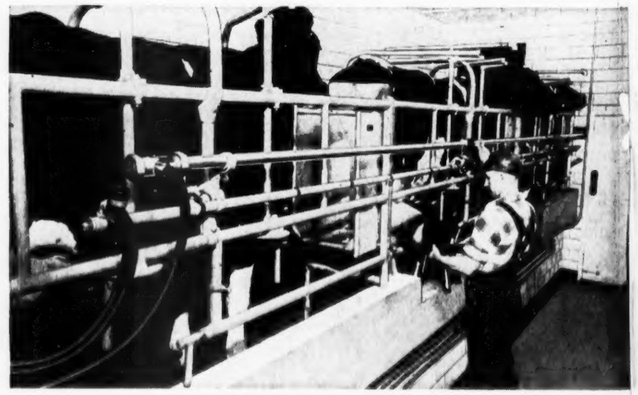
The years of research devoted to the development of loose housing have borne results that also benefit stall-barn owners. State agricultural experiment stations, equipment manufacturers, dairymen, USDA researchers—all cooperated in this work, which already contributes to more efficient, economical dairy production.

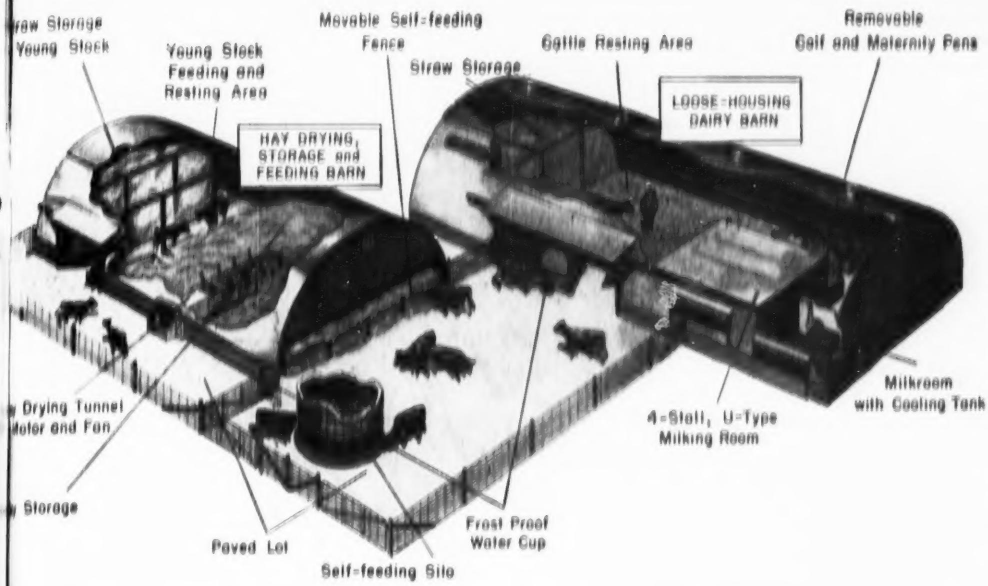
Milking plant

MILKING PARLOR has raised stalls, which cows enter through door at left and leave by rear center door. To left of loading platform are lavatory and feed room. Milkhouse (right) has a milk-can cooler.



ELEVATED STALLS eliminate practically all bending and stooping by operators, help speed up milking. This 3-in-line stall arrangement with pipeline system enables man to milk 20 to 25 cows per hour.





MAIN FEATURES of typical loose-housing system are shown in this complete layout, which uses steel barns. Paved open lot (center) connects the feeding area with the resting area for adult cows in the barn at right. Young stock is housed and fed separately in far end of the smaller barn at left.

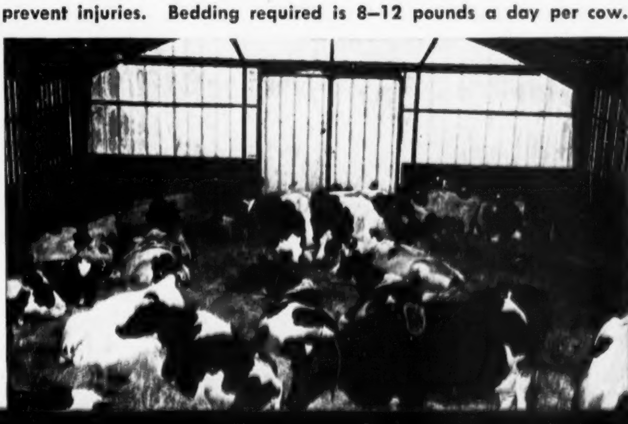
Feeding area

BALED HAY stored in this feeder is fed from two sides. Water tank (A) is on south side for protection against winter winds. If roughage is accessible at all times, 12–18 inches feeder space per cow is ample.

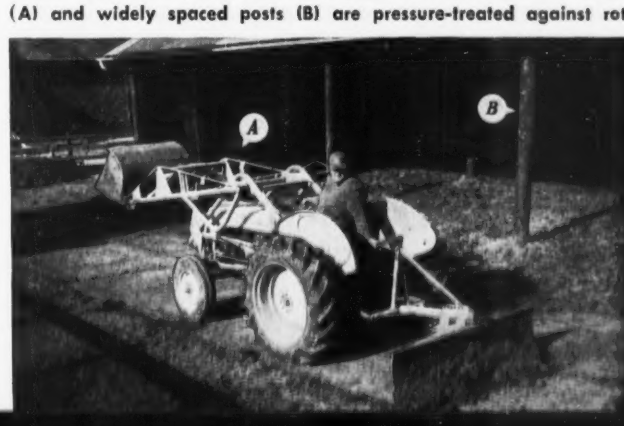
SILAGE is hand-fed from this open-lot bunk. Hinged doors (A) give access to silo. Self-feeding is possible with some silos (see drawing above). A movable fence may be used to self-feed from trench silos.

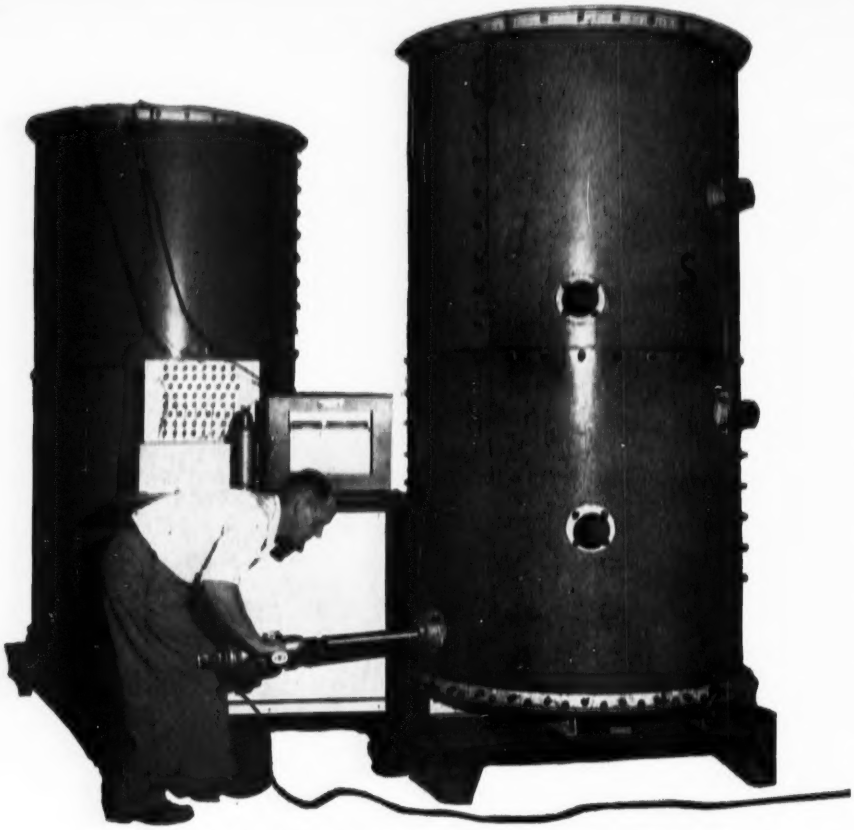
Resting area

SHELTER from wind, snow, and rain is provided in shed, usually open at front. Deep pack of manure and straw bedding gives warmth, helps prevent injuries. Bedding required is 8–12 pounds a day per cow.



CLEANING paved strip in front of the resting area and removing manure pack is easy with tractor equipment. Shed's retaining planks (A) and widely spaced posts (B) are pressure-treated against rot.





TEST SILOS of glass-coated steel, 8 feet high, simulate conditions in farm-size silos but need only 1 or 2 tons of forage. Samples are bored often to check development. Instruments keep constant record of temperature.

What makes *Silage?*

Silage—popular for 50 years—is still made by trial-and-error. No one yet fully understands how a green crop turns into fermented feed.

That's why scientists at the Agricultural Research Center are studying the mysteries of grass silage production. Many factors seem to be involved—season, kind of crop, maturity, moisture, protein, length of cut, packing, type of silo.

Dairy husbandmen are seeking ways to make palatable, nutritious silage every time. Chemists are looking into the role of silage acids and comparing the composition of green plant and final product. Bacteriologists are identifying silage bacteria—nearly a hundred types have been found so far—and learning how they grow and what they do. Engineers are dealing with such matters as equipment, moisture, temperature.

This team has already made some interesting discoveries. They find that the millions of bacteria on grass multiply rapidly after forage is cut and while it's being wilted. The buildup continues for 1 to 8 days after the grass is hauled in and stored.

In the silo, plant enzymes, yeasts, and molds may also be active for a while. The green plants continue to breathe, and forage temperature rises. At the same time, new acid-producing bacteria begin to appear.

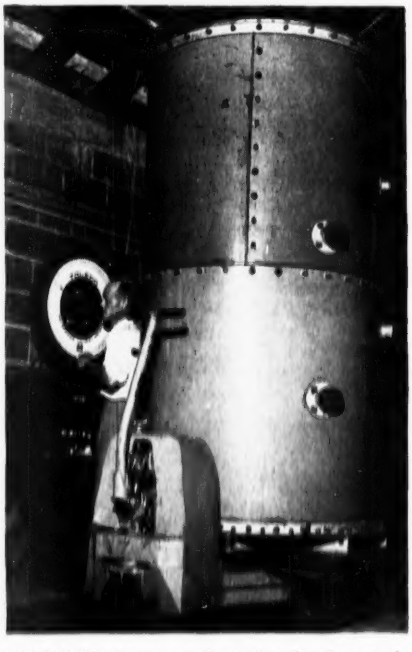
Most of the original bacteria like air and dislike acid. They disappear as plant and bacterial respiration uses up oxygen in the silo and acid development begins. These bacteria are usually gone within 15 days.

Now, in the oxygen-free atmosphere, the acid-producing bacteria take over. They include organisms that make lactic acid, characteristic of good silage. When lactic acid is plentiful, there's little trouble from foul-smelling butyric acid.

After the early buildup, bacteria numbers taper off for about 60 days, then increase slightly again.

Desirable fermentation seems favored by crop moisture of 65 to 75 percent, storage temperatures between 80° and 100° F., and absence of air.

Engaged in the study are dairy husbandmen L. A. Moore and C. H. Gordon, bacteriologists L. A. Burkey and J. T. Kroulik, biochemists H. G. Wiseman and C. G. Melin, Bureau of Dairy Industry; and engineer L. E. Campbell, Bureau of Plant Industry, Soils, and Agricultural Engineering.



WEIGHING shows total starting load, reveals loss from fermentation. Spoilage, seepage are also measured. Silo can be made airtight.

GOOD PRODUCT GETS BETTER

There's a new and better way to give frozen concentrated orange juice its fresh-fruit flavor. Developed at the Bureau of Agricultural and Industrial Chemistry's Pasadena (Calif.) laboratory, it offers savings in orange processing that can benefit growers, juice-concentrate manufacturers, and also consumers.

Frozen orange concentrate now on the market is a product of cooperative research by scientists of the Bureau's Winter Haven (Fla.) laboratory and the Florida Citrus Commission. Its current output is nearly 50 million gallons a year from Florida and California fruit. In a processing industry this size, even small improvements can have large value.

The new flavor-adding technique, however, looks like a *big* improvement. In the present process, fresh orange juice is added to restore the natural flavor lost from the concentrate during vacuum evaporation. To insure proper strength of the final product, the original juice must be over-concentrated before "cutting back" with the fresh, single-strength juice. But this calls for extra evaporation, which is expensive—and, besides, the cutback does not restore all the lost flavor.

Working to overcome these difficulties, scientists at the Pasadena laboratory discovered that most orange flavor comes from volatile oils contained in the peel. They tried adding a small amount of cold-pressed orange oil—in place of fresh, single-strength juice—to restore concentrate flavor. It worked. By this method the researchers obtained a better tasting orange-juice concentrate, which holds up in frozen storage as well as that made in the usual way.

Since the amount of orange oil added per can of frozen juice is very small, processors don't have to over-concentrate the fresh juice to obtain a normal 4-to-1 product (reconstituted by adding 3 parts water). As a result, this type concentrate can be made at lower cost.

But there's another advantage, too. Since orange oil readily restores the full, natural flavor lost during evaporation, it becomes practical to make more highly concentrated orange juice—for instance, a 6-to-1 product. This superconcentrated juice is highly satisfactory in flavor quality and storability. Though evaporation cost is necessarily increased, a 6-to-1 orange concentrate still offers substantial savings because of lower costs for containers, frozen-storage space, and transportation.

Moreover, the resulting new use for orange oil means another market for orange-crop byproducts to help cut over-all processing costs.

Conserving the volatile flavors of jellies and preserves

Remember those tantalizing aromas that pervaded the house at jelly-making time? Maybe you wondered why the jelly, good as it was, never tasted quite as delicious as it smelled while cooking. The fact is, of course, that much of the fragrance and flavor of the fruit escaped with the steam from the open kettle.

But now scientists at the Bureau of Agricultural and Industrial Chemistry's Eastern Regional Research Laboratory have developed a way to save that lost flavor.

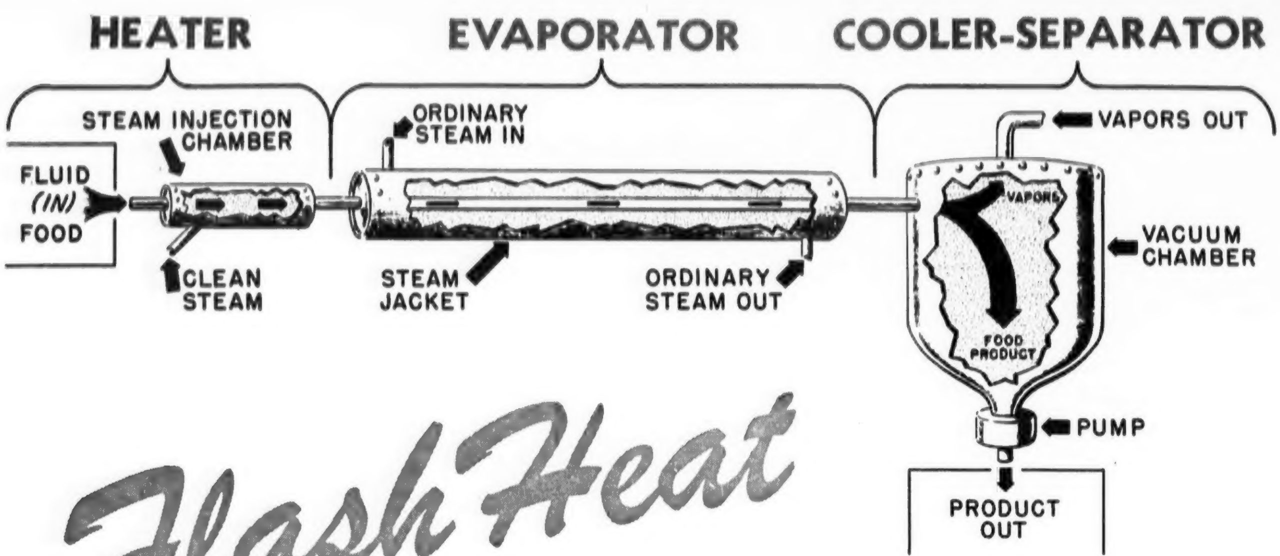
They find that volatile fruit flavors can be recovered in commercial production of jelly and preserves, just as they are from fresh juice. The method used is similar to that previously devised at the laboratory for capturing fresh-fruit flavor essences, which led to the popular frozen grape and apple juice concentrates and other new foods that have increased natural fruit flavor.

Essences made as a byproduct of preserve manufacture promise to be just as valuable commercially as the fruit-juice essences now used.

Heating develops the flavor of some fruits, and essence from their preserves is stronger and often tastes better than that taken from the fresh juice. It has the cooked flavor characteristic of preserves.

But essence flavor is elusive, and there seems to be little practical advantage in returning it to the preserves themselves. Though increased taste quality can be obtained, it may fade away in storage. A better prospect is to use preserve essences in other foods that can benefit more from enhanced fruit flavor—ice cream, beverages, candies, sundae toppings, and baked goods.

Excellent essences have been made in the laboratory's pilot plant from cherry, strawberry, peach, and blackberry preserves. To capture their volatile flavor substances requires only slight changes in ordinary preserve-making methods. The aroma and flavor otherwise lost from a hundred pounds of preserves, when caught and concentrated, will produce about a pint of fruit essence.



Flash Heat saves flavor

A FLASH-HEATING system that can sterilize, concentrate, and cool fluid foods—all in one short second—may spell higher quality fruit and vegetable juices, purees, soups, concentrates, and milk products.

This new flavor-saving process is based on known principles of steam-injection heating that were previously little used in preserving foods. It was developed for commercial use by A. H. Brown and associates at the Western Regional Research Laboratory, Bureau of Agricultural and Industrial Chemistry.

The system uses high temperatures, applied for very short times, to kill bacteria and to inactivate enzymes in food without destroying flavor.

Prior to the research by Brown and his coworkers, no commercial equipment was available to take advantage of the high-speed operation possible with this method of sterilizing fluid foods. Now several companies are using equipment designed at the Western Laboratory, and wider application of the process is expected.

Flash-heating equipment (see diagram) includes a steam-injection heater, which sterilizes the food, and a single-tube evaporator, which vaporizes the excess water introduced by the steam and can also concentrate the product if desired.

Following these two units is a vacuum chamber, or vapor separator, which serves to cool the food quickly for packaging. Simultaneously with the cooling action, the unwanted water is removed as vapor. This vacuum chamber can also separate the volatile flavor substances, which are then condensed to an essence by means of other equipment.

Here's roughly what happens inside the system: Fluid food such as fruit juice, flows under pressure into the heater and is sterilized by mixing with specially cleaned steam. The rate at which the food is fed in, and the amount and pressure of steam admitted, governs the temperature reached inside the heater and the time necessary for sterilization—usually not longer than a split second.

The food then passes at high velocity through a small orifice into the steam-jacketed evaporator. Its high speed causes it to exert a scrubbing action that keeps the evaporator walls clean and prevents formation of a film of cooked food in the tube. Heat applied through steam in the jacket surrounding the tube vaporizes the water in the food, thus permitting concentration if desired.

When the product is flashed into the vapor-separator unit, rapid evaporation in the vacuum chamber cools it in a fraction of a second. Water vapor and volatile flavors are carried off at the top by the vacuum, and a pump at the lower outlet of the chamber moves the final food product into containers.

The entire process, from heater to vacuum chamber, usually takes about one second. It provides a rapid, continuous flow of processed food, which remains in the system long enough for effective sterilization and concentration but moves fast enough so that unwanted changes in flavor are kept to a minimum.

Pilot-plant tests show that the system works well with the juice from grapes, apples, and tomatoes; with purees from apricots, peaches, and berries; and also with milk.

Two superior new SOYBEANS

Two new soybean varieties—Clark for the northern Corn Belt, and Jackson for the Southeast—were announced recently by ARA and State experiment stations cooperating in their development. Each has qualities that promise farmers lower production costs per bushel.

These are the latest of 12 superior varieties of soybeans—adapted to different producing areas—developed through State-USDA research during the past dozen years. Both of the new varieties will be released to certified seed growers next spring for buildup of planting stocks. They'll be ready for general use by farmers in the spring of 1955.

Cooperating in the release of Clark are the experiment stations of Nebraska, Iowa, Illinois, Indiana, and Missouri. States that aided in the development and testing of Jackson are Virginia, North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, and Louisiana. USDA research on both varieties was done by scientists of the Bureau of Plant Industry, Soils, and Agricultural Engineering, and the U. S. Regional Soybean Laboratory.

Map shows regions for which the new varieties are recommended.

CLARK does well in most of the region where the Wabash variety is popular and in the southern part of the area where Lincoln is grown. Clark is high in yield and oil content and resistant to frog-eye leaf spot disease. Test yields average more than 41 bushels per acre—4½ bushels higher than Lincoln and 6 bushels higher than Wabash. Plants are medium tall, with purple flowers. They mature about seven days later than Lincoln and a day or so earlier than Wabash. Clark may prove well adapted also to certain locations east of the area shown.

JACKSON is adapted to a broad belt extending from northern Louisiana to southern Virginia, where Roanoke is the most popular variety now grown. Jackson is not intended to replace the older variety, but its high yield (averaging about 1½ bushels per acre better than Roanoke), resistance to lodging, and suitability for combine harvesting, promise increased returns to many growers. Plants are medium tall, with white flowers. Maturing slightly later than Roanoke, Jackson does best on light soils but is suited also to heavy, poorly drained soils.

DEXTRAN *(from p. 3)*

75,000. (A glucose molecule weighs 180, so it takes more than 400 of them to make a clinical-dextran molecule.

Dextran molecules that weigh below 25,000 won't stay in the blood long enough. If they weigh above 200,000, they may cause clumping of red blood cells. At least 90 percent of clinical-dextran molecules must have a molecular weight between 50,000 and 100,000.

To meet these strict standards takes complicated production equipment and meticulous control at all stages of dextran manufacture. There are four main steps in the process:

FERMENTATION of dextran-producing bacteria in a solution of sucrose (beet or cane sugar) and water, with added nitrogen, vitamins, and minerals, to obtain long-chain dextran.

HYDROLYSIS of this native dextran with hydrochloric acid to break up its too-large molecules into a product with molecular weights of a few hundred to a million.

FRACTIONATION, using alcohol to precipitate the heavier dextran, leaving the lighter molecules in solution. Repeated fractionations are required to get clinical dextran in the proper molecular-weight range.

EVAPORATION AND DRYING to remove alcohol and water, which produces a white powder—the clinical dextran.

In the improved method developed at the Northern Laboratory, dextran-producing bacteria are not used directly. They are grown separately to yield a special enzyme. Under proper control, this enzyme alone reacts with sucrose to synthesize dextran. The resulting product is predominately of the right size for medical use.

The new method requires no hydrolysis, and fewer fractionations are needed to separate clinical dextran from that with too-low or too-high molecular weight.

Dextran's main advantage over other blood-plasma volume expanders—such as glucose or saline solutions—is that it persists in the blood longer—for days rather than hours. It also has several advantages over blood plasma itself. Dextran can be sterilized, while plasma cannot. It is free of the virus, sometimes present in plasma, which causes a jaundice-like liver infection. It keeps indefinitely without refrigeration. And its cost is roughly one-third that of plasma.

Finally, dextran can be produced from beet or cane sugar in quantities that are limited only by available processing facilities—not by the number of available donors.

New double-flowering stock

Florists now have a new, double-flowering column stock, which can be selected in the seedling stage to produce 100-percent double flowers. Seed supplies are now being increased for next year's retail trade.

With this variety, growers can cut costs of stock production by early elimination of single-flowered plants, which have little market value.

The new variety—called "Double Pink"—is unique in producing two types of seedlings—half with dark green foliage, which will bear single flowers, and half with foliage of lighter green, all of which produce double flowers. By removing the darker plants in thinning or transplanting, the grower gets a crop consisting entirely of double flowers.

Double Pink was developed by R. N. Stewart of the Bureau of Plant Industry, Soils, and Agricultural Engineering. Working with stock of German origin, he found a branched, outdoor type that carries a genetic link between color of leaf and doubleness of flower. The new variety is a result of crosses made within the German lines between this outdoor stock and plants of the column type.

The double-flowering characteristic is now being transferred to American column-type stocks, and a new deep-red variety will be released this year for seed increase. White and other shades are in the making but are not yet ready for trial.

Stocks are especially interesting from the scientist's standpoint. Of the two distinct types—single-flowered and double-flowered—only the single-flowered form produces seed. Within this type, geneticists have found three sub-types—one that produces no double flowers (called a "pure single"), a second that produces 25 percent doubles, and a third that produces 54 to 56 percent double flowers. Plants of the third type are called "ever sporting."

Stewart's finding of the link between leaf color and doubleness of flower makes it possible for seed producers to check their lines easily and to separate the pure singles from the ever-sporting singles.

If, within 2 weeks of planting, half the seedlings from a single plant selection show normal green leaves, while the other half are pale green, the plant is definitely ever sporting and carries the genes for double flowers. Plants of this type are the ones to use for seed production.

FRUITS and VEGETABLES

Greater effects from Growth Modifiers

A push from boron can speed the intra-plant travels of growth modifiers such as 2,4-D.

This discovery indicates a possibility for improving the effectiveness of these chemicals, which have many uses in lawns, orchards, and fields.

The research with boron—widely known in its borax and boric acid forms—was done cooperatively by J. W. Mitchell of the Bureau of Plant Industry, Soils, and Agricultural Engineering, and W. M. Dugger, Jr. and H. G. Gauch of the Maryland Agricultural Experiment Station.

Their findings are tied to the fact that green plants make sugars in their leaves. Everyone knows this process as photosynthesis. It's a matter of gathering the sun's energy by means of chlorophyll and thereby turning carbon dioxide and water in sugars—the basis of our carbohydrates, fats, and proteins. These sugars are then moved—or translocated—to other parts of the plant.

Mitchell observed that movement of 2,4-D from leaves to stems is related to the movement of sugars. Recently, Gauch and Dugger found that boron steps up the translocation of common table sugar absorbed by the leaves of bean and tomato plants. It was evident that 2,4-D might ride along on such a boron-accelerated trip.

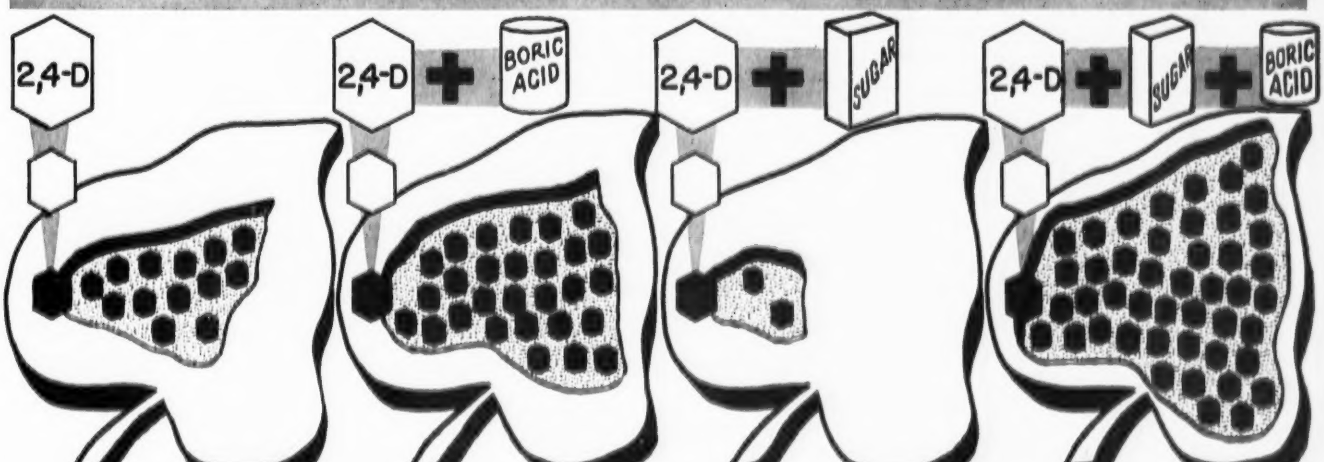
The scientists used radioactively-tagged 2,4-D in preliminary darkroom trials with beans. Without light, it was impossible for the plants to make sugars of their own. The tip of one leaf on each plant was dipped into a sugar solution, and the upper surface of the rest of leaf was painted with radioactive 2,4-D.

Sugar was absorbed and moved to other parts of the plant, carrying along 2,4–D that the leaf had also taken in. When the scientists added boric acid to the sugar solution, they found that nearly 50 percent more radioactive growth modifier was moved to the bean stems.

This success led to further research in which translocation was measured in terms of the freakish growth that 2,4–D produces. Applied to one bean leaf, the growth modifier moves down and causes the cells to lengthen abnormally on that side of the stem. This pushes the top of the plant in the opposite direction. The way in which beans reacted to various treatments is shown in the pictograph below. Similar results were obtained in tests with three other types of growth modifiers.

These results suggest that extra sugars, supplementing those made in the plant, might eventually be used along with boron to step up movement of growth-modifying chemicals. Glucose, or grape sugar, works even better than sucrose or fructose.

Boron speeds sugar movement, helps plants absorb and move 2,4-D



2,4-D alone, absorbed by leaf and moved with plant's sugars, caused bending of bean stems.

Boric acid increased movement of sugars and 2,4-D. Bending of plants was twice as severe.

Adding extra sugar appeared to dilute 2,4-D. Beans bent much less than with the 2,4-D alone.

Using all three increased bending greatly. Boron moved more sugar, overcame dilution effect.

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OFFICIAL BUSINESS

AGRISEARCH Notes

RESEARCH à la carte

On their recent visit to Beltsville (see p. 2), President Eisenhower, Secretary Benson, and their party saw not only how agricultural research projects are conducted in the field, but also how their results look—and taste—in final form on the table. All ARA bureaus collaborated in providing the new foods and other products set before the guests at this research luncheon. Served buffet style, the menu offered these items:

APPETIZER—ORANGE JUICE from the new orange powder (AGR. RES., Mar.–Apr. 1953), which can be stored without refrigeration. Reconstituted with water, it looks and tastes like the fresh juice from which it is made—and has the same nutritive quality.

MAIN COURSE—PRIME RIBS OF BEEF from a purebred Black Angus, one of those used in twin-calf experiments demonstrating that young animals on reduced rations gain rapidly when put back on full feed, and that the quality of their meat equals or surpasses that of animals raised on continuous full feed. BAKED HAM from the new meat-type hog, which produces more lean pork in relation to fat. GLAZED SWEETPOTATOES of a new, unnamed variety resistant to black rot disease, prepared from a recipe developed for institutional use. POTATO SALAD, also prepared from a research-tested, large-quantity recipe, using the new multiple-disease-resistant Kennebec potatoes. GREEN PEAS preserved by dehydrofreezing (partial drying followed by freezing), a method of food processing that can reduce storage and transportation costs. The peas were served with MUSHROOMS grown under improved methods of insect control to give higher yields and better quality. The same methods were used to produce the ASPARAGUS also on the menu. LETTUCE of the new Salad Bowl variety, a slow-bolting type with tender, well-flavored leaves, adapted to all our lettuce-growing areas. HYBRID ONIONS of several varieties, developed for high yields, disease resistance, and mild flavor. LEMON ICE from frozen, fresh-lemon puree, a product that gives new outlets for fully ripe fruit not suitable for shipping. WHOLE WHEAT ROLLS with added protein and iron from non-fat milk solids and molasses, prepared from a recipe developed for school-lunch menus.

DESSERT—FRESH STRAWBERRY PIE made with Temple strawberries, a variety resistant to red stele root disease and with good shipping and eating qualities.

BEVERAGE—MILK with increased non-fat solids and reduced fat, providing a beverage that is low in calories but highly nutritious.

SPECIALTIES—POTATO-CHIP BARS, tasty new high-energy food for military emergency rations, but also attractive to civilian consumers. CHEDDAR CHEESE of superior quality made in half the usual time (AGR. RES., May–June 1953). WHEY CHEESE SPREAD made from whey proteins. SWISS CHEESE made from pasteurized milk to give a safer product. HONEY-FRUIT SPREAD combining fruit juice and honey. COMB HONEY, from improved bees. CRYSTALLIZED HONEY, a new smooth-grained product. HOT-WEATHER CANDY that won't soften in tropical climates, another item of special interest to the military. PECANS of the new Barton variety, high yielding and thin shelled, with superior keeping quality. ALMONDS of the new, early-maturing Davey variety.

FLOWERS—EASTER LILIES and *Speciosum rubrum* LILIES grown from bulbs kept in storage under temperature conditions that force blooming at the desired time of year. DOUBLE PINK STOCKS (see p. 14). ROSES with attractive blossoms and longer stems, showing results of insect control with aerosols (AGR. RES., July 1953).

TABLE—The TABLE CLOTH was of washable, flameproof cotton developed as a military-uniform material and for other uses (AGR. RES., May–June 1953). PLACE MATS were of a linen-like fabric, made by special finishing methods from low-grade cotton. It looks, wears, and launders like linen but costs only a fourth as much.

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